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ABSTRACT

This experiment investigated the effect of a delay in informative feedback in computer-managed instruction upon later retention. Experimental groups of undergraduate college students were given a computer-managed test and received informative feedback (1) immediately, item by item (2 second delay); (2) following the entire test (20 minute delay); or (3) 24 hours later. A control group received no feedback. For items incorrect on the computer-managed test and later correct on the criterion test, the performance of both groups receiving delayed feedback was significantly better than the group receiving immediate feedback. Also for these items there was a significantly greater increase in confidence ratings in the 24 hour delay group than in all other conditions. (Author/WBC)

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DELAY OF INFORMATIVE FEEDBACK AND COMPUTER MANAGED INSTRUCTION

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Presented at American Educational Research Association, New York, April, 1977.

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Delay of Informative Feedback and Computer Managed Instruction

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Abstract

College undergraduates took a multiple-choice computer-managed test and received informative feedback, the entire item with the correct answer identified, either: (a) immediately item by item (2-sec. delay); (b) following the entire test (20-min delay); (c) 24 hr. later (24-hr. delay); or (d) no feedback. Retention, 1 to 3 weeks later, was significantly better for delayed feedback (20-min. + 24-hr.) than for 2-sec., occurring for items wrong initially and correct later. For these items, significantly greater increase in confidence ratings occurred for 24-hr. delay than for all other conditions. Previous findings were confirmed for computer managed tests in educational setting.

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Delay of Informative Feedback and Computer Managed Instruction

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This experiment investigated the effect of a delay in informative feedback in computer-managed instruction upon later retention of the material. Most programs for computer-managed instruction are based on the principle that immediate feedback of the correct response is crucial for learning to occur. Evidence does not support this principle for human learning of academic material. A number of studies have compared immediate and 24-hr. delay of informative feedback, that is, the interval between the student's response to an item and presentation of information about the correct answer. The findings are consistent: retention of the learned material, three to seven days later, is generally superior following delayed informative feedback. Superior retention with delayed informative feedback has been found to depend upon several factors, including the type of information provided as informative feedback (Sturges, 1972) and whether the student initially had the item correct or incorrect (Kulhavy & Anderson, 1972).

The present research explored the applicability to computer-managed instruction of previous experimental findings on the effect of delayed informative feedback. The conditions were as similar as possible to those of previous research. Both the computer managed test and the retention test had multiple-choice items. One form of informative feedback was used, the entire item with identification of the correct alternative. Previous studies have compared 24-hr. delay of informative feedback with one of two immediate feedback conditions: (a) informative

feedback presented immediately item-by-item (2-sec. delay); or (b) the series of informative feedback presented immediately following the entire test (20-min delay). This experiment compared these three feedback delay intervals (2-sec., 20-min., and 24-hr.) with a control group receiveing no informative feedback.

Items correct or incorrect on the initial test were analyzed spearately. Also, two additional measures were used: state anxiety and confidence ratings. The short form of the A-State scale has been found to be sensitive to changes in anxiety during computer-assisted instruction sessions (e.g., O'Neil, 1972). This scale was used to investigate the hypothesis that there are differences in anxiety at the presentation of informative feedback for the different conditions. Confidence ratings on each item for both tests were used to provide a broader scale and thus, a more sensitive measure of change from the initial to the criterion test.

Method

Subjects, design, and materials. 112 undergraduates enrolled in Child Psychology, with two sections for each of two instructors, were randomly assigned to one of four informative feedback groups (no feedback, 2-sec., 20-min., and 24-hr. delay). The computer-managed test (CMT) had 30 4-choice items from Biehler (1976). Informative feedback was the representation of the entire item, with a statement indicating the correct alternative (e.g., "alternative C is correct"). The criterion test included the 30 items on the CMT. For both the CMT and the criterion test, the student marked the degree of confidence he had in each choice, writing a whole number from 1 (guess) to 9 (certain).

Procedure. All students attended a lecture-discussion section

with the same text (Blehler, 1976). Except for the CMT and the criterion test each instructor conducted his classes in his regular way, which differed in some relevant ways. For both instructors participation in the CMT and the criterion test was a requirement of the course; but for one instructor the grade in these tests contirbuted to the grade in the course and for the other it did not. One instructor provided informative feedback with an explanation of each item following each quiz in his class. For the other instructor quizzes were not reviewed in class.

Students in all groups took the CMT via the interactive testing program between the 11th and 13th weeks of the semester, using CRT terminals of a DEC PDP 11/45 computer. Each student reported to the computer testing room for two sessions, 24 hrs. apart. On the first session each student was given the test on the computer, one item at a time, and recorded his response and confidence rating to each item. Students in the 2-sec. and 20-min.feedback conditions received informative feedback at the appropriate times. On the second session, students in the 0, 2-sec., and 20-min. feedback conditions received their scores on the quiz, the number and percent correct. Students in the 24-hr. feedback condition received informative feedback and then their scores on the quiz. The criterion (retention) test was given one to three weeks after the CMT in the regular class period. Each student was given the short form of the A-State scale before and after each task on both sessions of the CMT and following the criterion test.

Results

The mean correct on the CMT and on the criterion test were

analyzed by analysis of variance. There was a significant gain from the CMT to the criterion test, F (1, 104) = 48.56, $p < .01$. There was no significant effect of feedback conditions on the computer test, F (3, 104) = 0.40; but there was a significant effect of feedback conditions on the criterion test, F (3, 104) = 6.70, $p < .01$. Three *a priori* planned orthogonal comparisons indicated that the mean correct for the three feedback conditions combined (2- + 20- + 24-) was significantly greater than that for the group with no feedback, F (1, 104) = 15.56, $p < .01$. Also, the mean correct for the two delayed feedback conditions combined (20- + 24-) was significantly greater than that for 2-sec. feedback, F (1, 104) = 4.54, $p < .05$. There was no significant difference between 20-min. and 24-hr. delay of feedback on this measure.

Analyses indicated that the effect of feedback delay upon the criterion test performance was accounted for by the proportion of items wrong on the CMT and correct on the criterion test. For these items, the proportion for 24-hr. (.72) did not differ significantly from that for 20-min. (.67), but these two delay groups were significantly higher than the 2-sec. group (.53), which was higher than the control group (.39).

The degree of change in confidence rating from the CMT to the criterion test was analyzed for items right or wrong on the CMT and the criterion test. There was a significant effect of feedback conditions, F (3, 3344) = 5.58, $p < .01$, and a significant interaction between feedback and type of item, F (9,3344) = 8.15, $p < .01$. For items initially wrong but correct on the criterion test, there was a significantly greater increase in confidence for

the 20-min. delay than for the 2-sec. delay, and for the 24-hr. delay group than for each of the other three groups (Newman-Keuls, $p < .01$).

On the CMT, there was no significant effect of feedback conditions upon the total time to answer the 30 items, $F(3,96) = 2.47$, or upon the total time spent on informative feedback, $F(2, 73) = 1.81$. Also, there was no significant effect of feedback conditions upon the A-state measure during presentation of informative feedback, $F(3, 80) = .43$.

Discussion

As in laboratory experiments with academic material, immediate presentation of information about the correct alternative on a computer managed test does not result in greater retention than delay of informative feedback. Some delay of informative feedback improved retention performance. This occurred in a situation in which there was no control of the amount of studying before the computer managed test and between that and the criterion test, whether or not the students were graded on these tests, and whether or not they were used to receiving feedback for quizzes in class.

Several experimenters have used the 20-min. delay condition as immediate informative feedback. However, this condition is a delay of approximately 20 min. between the student's response to an item and presentation of informative feedback. The lack of a difference between 20-min. and 24-hr. delay in this study could be due to several factors, one of which is the relative ease of the initial test ($\bar{X} = 69\%$). Analysis of the criterion test performance as a function of three levels of difficulty of items on the computer

managed test (percentage of students correct) indicated that the effect of feedback conditions occurred only for the most difficult items. This suggests that a more marked impact might be expected for a more difficult initial test.

Considering degree of change in confidence rating as a more sensitive measure of learning, 24-hr. delay of informative feedback was superior to the other conditions. For items initially incorrect and later correct the 24-hr. delay resulted in a greater increase in confidence that they were, in fact, correct. This is interpreted as supporting the hypothesis that, after a delay interval, students process the information presented at feedback more completely than when it is presented immediately. Further research is planned to explore the effect of delay of informative feedback in computer managed instruction and other variables, repeated tests and type of feedback.